DOCUMENT RESUME

ED 134 928 CS 003 181

AUTHOR Alessi, Stephen M.; And Others
TITLE Hardware and Software Considerations in Computer Based Course Management. Technical Report No. 4.
INSTITUTION Illinois Univ., Urbana. Center for the Study of Reading.
SPONS AGENCY National Inst. of Education (DHEW), Washington, D.C.
PUB DATE Nov 75
CONTRACT N61339-73-C-0078
NOTE 21p.

EDRS PRICE MF-$0.83 HC-$1.67 Plus Postage.
DESCRIPTORS *Computer Assisted Instruction; *Computer Oriented Programs; Higher Education; *Instructional Programs; *Management Systems; Systems Concepts
IDENTIFIERS *Center for the Study of Reading (Illinois)

ABSTRACT

Three of the more obvious advantages of using a computer to coordinate the logistics of a multifaceted instructional program with large numbers of students are the computer's ability to reliably control student activities, to keep and analyze data, and to make available instructional and evaluative materials. This document describes a computer-based course management system (CAISMS II) and its hardware/software organization as it was developed and implemented on the PLATO IV computer-based instructional system centered at the University of Illinois. The system is intended for courses in community colleges, universities, or military settings. Diagrams illustrating the text are included. (JM)

****
* Documents acquired by ERIC include many informal unpublished *
* materials not available from other sources. ERIC makes every effort *
* to obtain the best copy available. Nevertheless, items of marginal *
* reproducibility are often encountered and this affects the quality *
* of the microfiche and hardcopy reproductions ERIC makes available *
* via the ERIC Document Reproduction Service (EDRS). EDRS is not *
* responsible for the quality of the original document. Reproductions *
* supplied by EDRS are the best that can be made from the original. *
****

ED134928

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

Technical Report No. 4

HARDWARE AND SOFTWARE CONSIDERATIONS IN COMPUTER BASED COURSE MANAGEMENT

Stephen M. Alessi, Thomas H. Anderson,
& W. Barry Biddle

November 1975

UNIVERSITY OF ILLINOIS at Urbana-Champaign
LABORATORY FOR COGNITIVE STUDIES IN EDUCATION
236 Education Building
Urbana, Illinois 61801

The research reported herein was supported by the Navy Personnel Research and Development Center and Advanced Research Projects Agency under Contract N61339-73-C-0078.

CS 003 181

Abstract

A computer based course management system (CAISMS II) was designed to integrate books, computers, and live teachers in an effective manner. The system is intended for courses with large numbers of students and instructors such as introductory courses in community college, university, or military settings. We here describe the course management system and its hardware/software organization as it was developed and implemented on the PLATO IV computer based instructional system centered at the University of Illinois.

Hardware and Software Considerations in Computer Based Course Management

There are several advantages in using a computer to coordinate the logistics of a multi-faceted instructional program with large numbers of students. Consider three of the more obvious and important ones.

The first advantage is a computer's power to reliably control activities. A computer can require particular activity sequences of a student, give him choices among various activities, notify him when analysis of his work indicates help is needed, provide remedial sessions, and coordinate off-line activities.

The second feature is record keeping and analytical power. Relatively large amounts of data on each student can be stored, easily retrieved, and analyzed for many purposes. This is necessary for remedial branching and advising, providing the student with detailed descriptions of his work, and providing his instructor with the same. Besides storing data with regards to on-line instructional material, the computer can handle general scheduling of class sessions and exams, student-staff communications, and grading. The storage and analysis of large amounts of data are useful not only to instructors but to instructional developers and evaluators for improvement of materials, analysis of overall class progress, and evaluation of work quality.

The third feature is the availability of instructional and evaluative materials. Many computing facilities are capable of providing more hours of continuous service than can be provided by the entire instructional staff

of the typical university course. Our present facilities can provide nearly twenty-four hour-a-day service for the student ambitious enough to make use of it. Even with large classes, hourly exams may be taken and retaken at the student's convenience to a greater extent than ever before, and with little human time and work. Students may also communicate with instructors, schedule exams, and get course information at many times other than class and office hours.

All of these advantages multiply in importance considerably as class size increases. In a course of 300 students, the quizzes, testing, seminar and exam scheduling, and grading would require hundreds of hours of work for instructors, but are performed quickly, at any time, and with very little error by computer.

Purpose

The primary purpose of automating course logistics is to free the instructor from simple but time consuming managerial tasks. CAISMS II aims to use instructors in roles where human qualities and skills cannot be replaced.

Teachers are used to instruct seminars rather than large lecture and discussion sessions. Seminars are offered in which class size is kept low, less than twenty-five students. Only students who have mastered required background work are allowed to register so that the discussion is informed. An important point is that seminars would not be economically feasible within traditional introductory courses in most American universities. CAISMS II makes them possible because the teacher is saved from

lecturing, routine review, and from most of the clerical and management tasks involved in giving and grading examinations, keeping records and scheduling tutorial and group activities.

Furthermore, increased instructor time allows for more one-to-one remedial instruction with students who need help, or for whole classes on difficult material. Special adjunct lectures and review sessions were used to help students learn difficult material in the course. Let us consider the components of a course which has been managed by a computer with the primary objective of freeing instructors' time from the usual lecture, testing, and organizational activities.

Courseware Components

The backbone of the entire enterprise is CAISMS, the Computer Assisted Instruction Study Management System (Anderson, et al., 1974) which in a sense replaces traditional lectures and routine review sections. Using CAISMS students are expected to acquire basic course information and concepts principally from individual reading. The idea is that students often fail to learn from text because they do not study it thoroughly enough. There is a range of evidence that procedures which induce meaningful processing of text facilitate learning (e.g., Barclay, 1973), and 75 years of research which indicates that asking people questions about what they are reading is an effective way of managing processing activities (Anderson & Biddle, in press). This is the technique implemented in the study management system.

Here is how CAISMS works. The student signs in at a computer terminal and receives a brief study assignment. Upon completing the assignment in a nearby work space, the student again signs onto the terminal. This time he receives a short quiz over the assignment just completed. If the quiz performance is below 75% correct, he reviews the same study assignment; if above 75% correct, he receives a new assignment. The quizzes are not graded but the student must pass a quota of them to become eligible for examinations which are graded.

After the student has made himself eligible for an on-line test (by completing required quizzes), he must reserve a time for testing by using an on-line reservation routine. CAISMS II keeps track of a student's eligibility and will not allow him to reserve a terminal until he has completed the proper reading assignments. Exams (which are proctored) are offered in the evening hours and occasionally on Sunday afternoons. Exams are generally about forty multiple choice items requiring an hour. Upon completion, test performance is judged and statistics are displayed. The student is shown the number of items correct, percent correct, his letter grade, and a profile of performance across the chapters of his textbook. The student can always return to look at these results, as well as inspect his cumulative grade in the course which includes all exams and seminars. If the test performance is not satisfactory to the student, he can choose to retake it on a later day getting a different form of the exam. After a very poor performance, the student is required to see an instructor for help before retaking an exam. The grade on the last exam taken is used in his cumulative record.

It should be emphasized that "remedial" activity is available or required at most levels of CAISMS II. Poor quiz performance requires restudy and retaking of the quiz, and if a student is dissatisfied with his performance in a seminar, he may attend another.

There are a number of minor components to CAISMS II, such as a third item bank of optional review questions for each exam, and a message exchange program for communication between instructors and students. For further information on these, the reader should refer to Anderson, et al. (1974, 1975a) and Alessi, et al. (1974).

Student Procedures for Using CAISMS II

Figure 1 shows the typical pattern of the student-computer interaction.

Insert Figure 1 about here

Options A through G are always available to the student while others like H through L are contingent on successful progress in the course and are not available at all times. The most common session is a student signing on, taking a quiz, receiving an assignment, and signing off.

Staff Procedures for Using CAISMS II

There are two types of staff that manage the system: the teaching staff and the technical staff. The teaching staff includes the lead professor, five graduate teaching assistants and six undergraduate tutors. The technical staff consists of the project director, a project manager and four graduate research assistants. The technical staff is large since the system is still in the developmental phase, but when the system becomes operational,

all the technical staff will not be needed. The staff can sign on the system at any terminal. Shown in Figure 2 is a schematic of the staff-computer interaction including three of the important reasons for signing

---

Insert Figure 2 about here

---

on. The staff has access to a large amount of current information and the opportunity to intervene and alter the procedural variables controlling student on-line activities.

Implementation

CAISMS has been used for four semesters in an introductory economics course at the University of Illinois. The first two semesters consisted of the study management system alone, while the latter two consisted of all the course management components.

During the first semester of CAISMS II 360 students attended the first class and received instructions on how the course management system works, how and where to sign on to the PLATO system, and specific topical areas to be covered in the course. Students began within a few hours after the initial meeting to sign on to the system and start the self-paced study. Approximately 200 students had taken the first study quiz by the end of the first week and 300 by the end of the fourth week. Approximately 275 students completed the course and received a passing grade.

Procedures during the second semester of the course were basically the same. About 400 students attended the first class of which approximately 320 finished and passed the course.

Hardware/Software Components Available

CAISMS and CAISMS II were implemented on the PLATO computer based educational system at the University of Illinois. The current PLATO system is a large scale CBE system consisting of a CDC cyber 73 computer connected to approximately 950 interactive graphics terminals. About 600 of the terminals may be used simultaneously by students, instructors, and programmers in as many different activities. All lesson material is stored on direct access disc so there is usually only a few seconds delay between the request for an activity and access to it. The PLATO system's unique hardware features also provide for excellent response time and allow a great variety of instructional methodologies.

PLATO software is also unique. TUTOR, the sole programming language on the system, is an educationally oriented language well suited for dialogue with the student, quiz and drill work, graphics for simulation, and mathematical power for lessons requiring analytics. A number of systems programs are available for producing and maintaining class rosters and student data, collecting basic summary statistics of lesson use, and for instructional development, testing, and improvement. One weakness in TUTOR is the programmer's limited control of data storage and transfer. Many standard computer facilities have more powerful data management features.

Hardware/Software Consumed

In the first two semesters of operation, which consisted of study management alone (CAISMS), about 70 students per semester used eight dedicated terminals available 16 hours a day. These students used a total of 55 minutes

of central processing time and 800 hours of terminal time per semester. In the third and fourth semesters of operation (CAISMS II), about 300 students per semester used 6 dedicated and 50 shared terminals available 16 hours daily. For each of those semsters, four and one half hours of central processing time, and 5,000 hours of terminal time were used.

Organization of Hardware/Software

The software configuration for CAISMS II consists of three main parts: student programs, staff programs, and shared data banks. The student programs pictured in the upper third of Figure 4 include quizzes, tests, scheduling, communications, information, and feedback routines. The staff

---

Insert Figure 3 about here

---

programs pictured in the lower third of the figure include student and class progress analysis, instructional materials monitoring and analysis, communications, information, and schedule monitoring routines. The student and staff routines are linked and share data via the shared data banks shown in the middle third of Figure 3.

Consider an example of how data is shared between programs. If a student is in program number five for a quiz, the program pulls questions out of question bank number six, and stores data generated by the students' answers in dichotomous item data bank number two. A staff member in program number three may retrieve those and other student's data from data bank number two to analyze individual student progress or do an item analysis of that quiz. A student in program number four for an on-line exam requires

confirmation of a reservation from calendar and reservation storage bank number nine, questions from question bank number six, and stores data generated in data bank number two. Staff members in program number three may see the student's results by retrieving his data from data bank number two, or in program number ten may retrieve reservations from reservation storage bank number nine to see who is planning to take an exam on any particular night.

Active memory space must be conserved to allow many students simultaneous access to materials. This is done by dividing the activities up into many small programs. During a session, a student may engage in many different activities, but uses only one small program at a time. In Figure 3 a student taking an exam needs only program number four and the associated data banks. After his exam he may look at his results, needing only program number one, and then he may leave a note for help to a teaching assistant, requiring only program number eleven.

One "router" program controls the student's movement among the different programs. When the student makes a request for a particular activity, the router considers that student's status and either fulfills the request, bringing the proper program into memory and switching control of the student to it, or tells the student he cannot engage in that activity at present and why. Staff programs are also managed by a router so that staff members may switch among programs and use them with absolutely no programming experience.

There are about ten student programs in CAISMS II requiring about 70 kilobytes of storage. The average student program with associated data banks occupies about 13 kilobytes in active memory. The common data banks them-

selves contain six basic kinds of data: dichotomous item data on between 450 and 1500 items per student, student and staff messages which are periodically deleted to make room for new ones, student reservations which are automatically deleted when they expire, student grades for off-line activities, information files, and question and answer files. These data banks occupy about 35 files with a total of approximately 750 kilobytes of storage. Many of these files are source code shared by students and staff, as in the cases of quiz and test items, and course information. There are about seven staff programs with a total of about 80 kilobytes and an average of about 17 kilobytes each when joined with their associated data banks.

The development of the present system occurred in parts over the last two years. Development of study management by two programmers required about 100 off-line and 250 on-line hours and 25 on-line hours of clerk time to load questions and answers into files. The addition of course management required an additional 100 off-line and 500 on-line hours of two programmers and another 40 hours of clerk time to load questions and answers.

Discussion

In some ways the hardware and software available were far more sophisticated than necessary for our purposes, while on the other hand some very useful facilities were not available. A few points are worth mentioning about what may and may not be required for such a system.

We would contend that it is possible, though obviously less elegant, to deliver such a system in a batch mode. Various mark sense and optical scanning devices are being used with some success in projects similar to ours.

On a slightly higher level, an interactive system without graphics capabilities would be capable of supporting a system just as flexible as ours for most subject matter areas.

The issue of large scale versus minicomputers is one we are currently investigating. The large scale system has the advantages of 1) a larger number of simultaneous users, 2) greater material variety, and 3) more powerful software. Minicomputers have the advantage of being dedicated and thus are more reliable since they are loaded with only necessary features and software. Preliminary investigations lead us to believe they would also be more cost effective in some situations.

We are also investigating the minimal software requirements for CAISMS II. The PLATO system has many built in management and record-keeping features, but many lack flexibility. Data analysis power, though quite good, is limited by restricted data transfer and access methods. A machine with more conventional software giving the programmer more control of storage and memory would have definite advantages. Those advantages might outweigh the built in record-keeping facilities and the almost entirely unused graphics capabilities of the PLATO system. On more conventional machines, however, the cost and time spent on programming, and the reliance on professional programmers, might increase.

Last is the issue of personnel. An attempt was made initially to develop generalized programs into which non-programmers could load various curricula. On the level of basic study management this was possible, but at the total course management level (CAISMS II) components became so specific to individual course needs that it became impossible to construct generalized

programs. A flexible CAISMS II system (which is easily modified in response to changing instructor needs) will require programming personnel not only for initial implementation, but on a continuing basis in order to keep the system up to date with the course, monitor it for errors, and perform general preventive maintenance.

The reliance on programmers, however, is not a great one. Our system was produced, debugged, and monitored largely by two half-time assistants with moderate programming experience. The concept of course management is simple and flexible enough, we believe, to be implementable and maintainable on a wide range of computer facilities, with at least moderately experienced personnel.

References

Alessi, S. M., Anderson, R. C., Anderson, T. H., Biddle, W. B., Dalgaard, B. D., Paden, D. W., Smock, H. R., Surber, J. R., & Wietecha, E. J. Development and implementation of the computer assisted instruction study management system (CAISMS). Technical Report NPRDC TR 74 - 29. San Diego: Navy Personnel Research and Development Center, 1974.

Anderson, T. H., Anderson, R. C., Dalgaard, B. D., Wietecha, E. J., Biddle, W. B., Paden, D. W., Smock, H. R., Alessi, S. M., Surber, J. R., & Klemt, L. L. A computer based study management system. Educational Psychologist, 1974, 11, 36-45.

Anderson, T. H., Anderson, R. C., Alessi, S. M., Dalgaard, B. D., Paden, D. W., Biddle, W. B., Surber, J. R., & Smock, H. R. A multifaceted computer based course management system. In O. Lecarme & R. Lewis (Eds.), Computers in Education. Amsterdam: North Holland Publishing Company, 1975. (a)

Anderson, T. H., Anderson, R. C., Dalgaard, B. D., Paden, D. W., Biddle, W. B., Surber, J. R., & Alessi, S. M. An experimental evaluation of a computer based study management system. Educational Psychologist, 1975, 11, 184-190. (b)

Anderson, R. C., & Biddle, W. B. On asking people questions about what they are reading. In G. Bower (Ed.), Psychology of Learning and Motivation (Vol. 9). New York: Academic Press, in press.

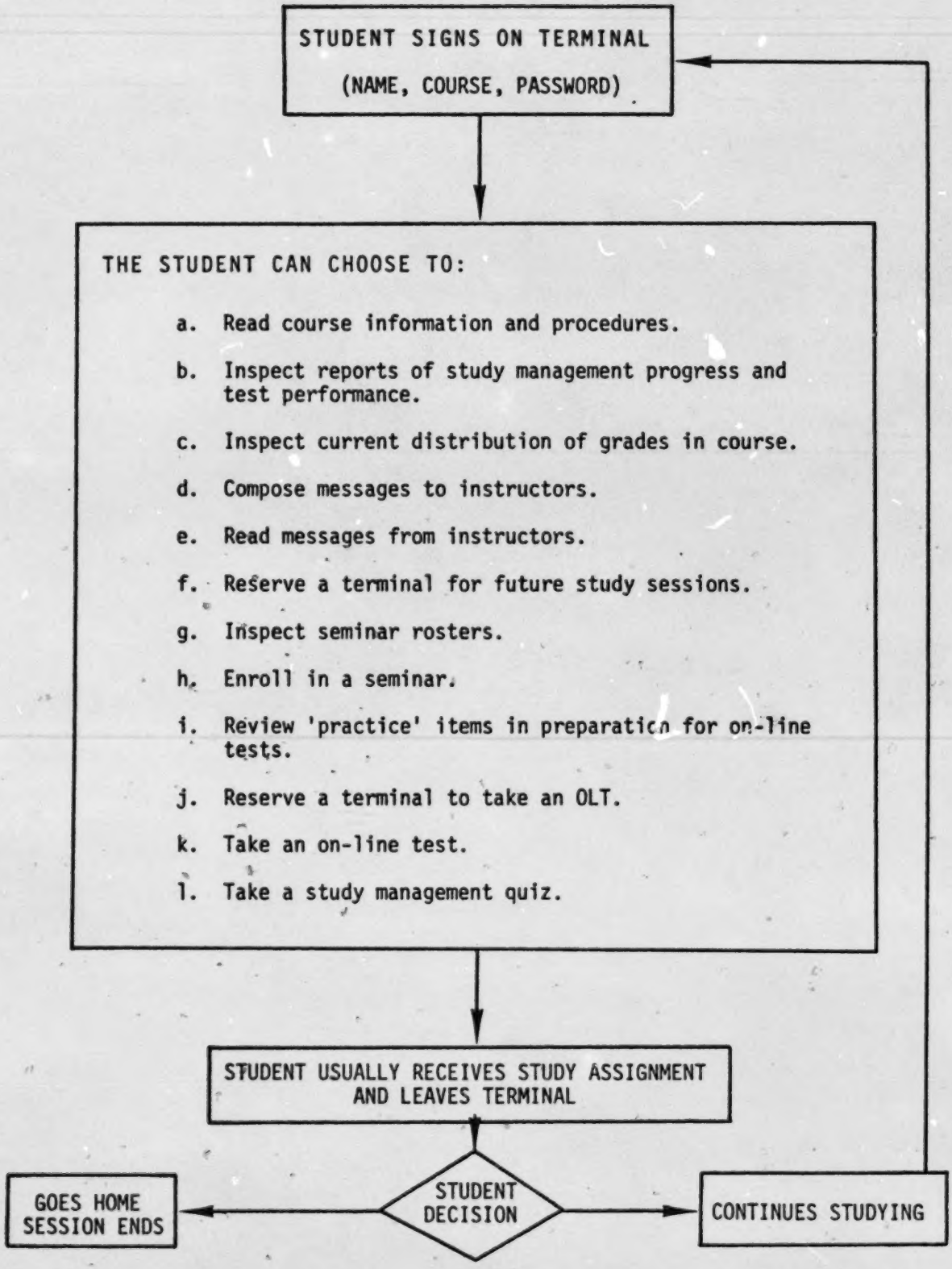
Barclay, J. R. The role of comprehension in the remembering of sentences. Cognitive Psychology, 1973, 4, 229-254.

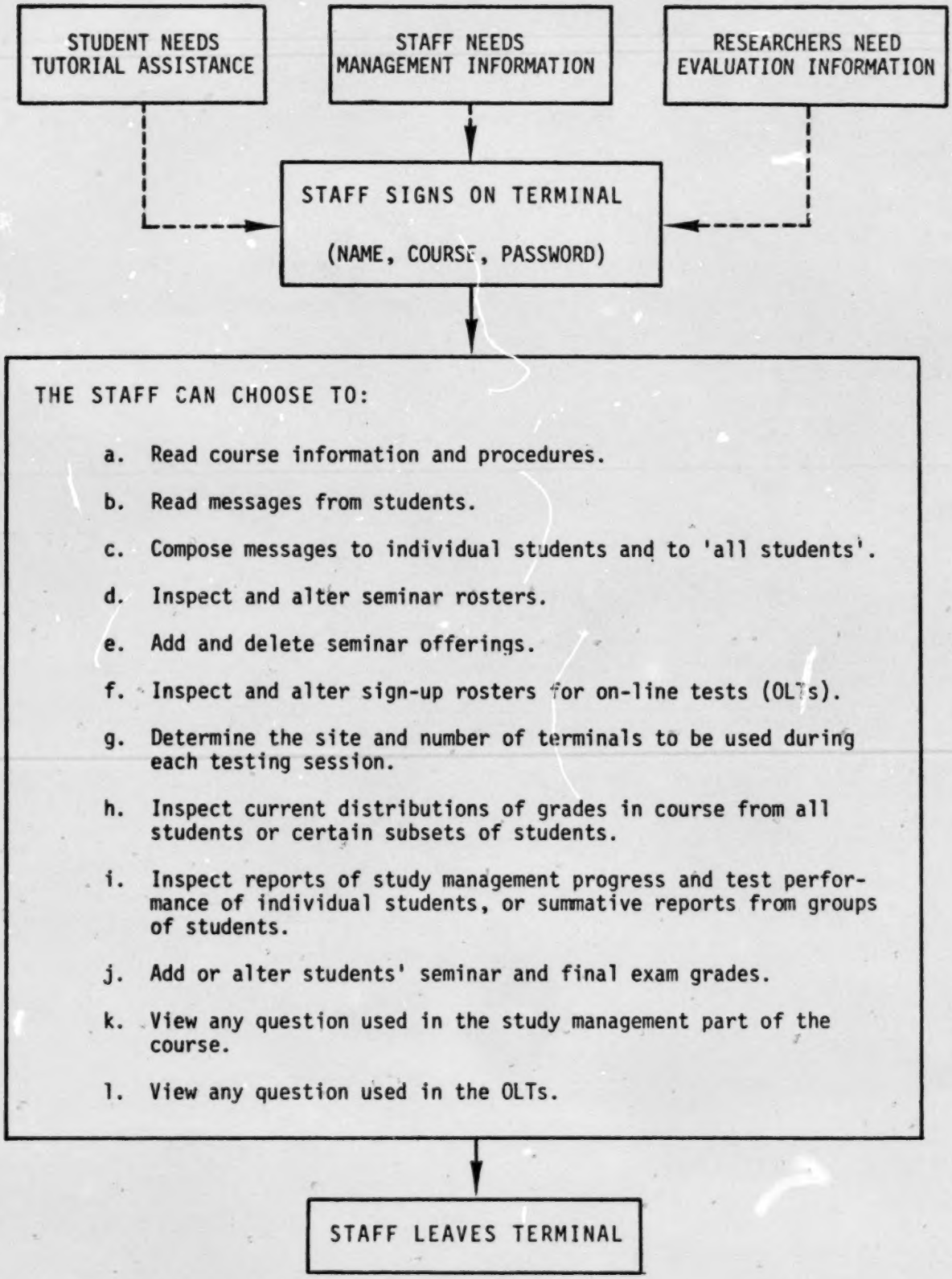
Figure Captions

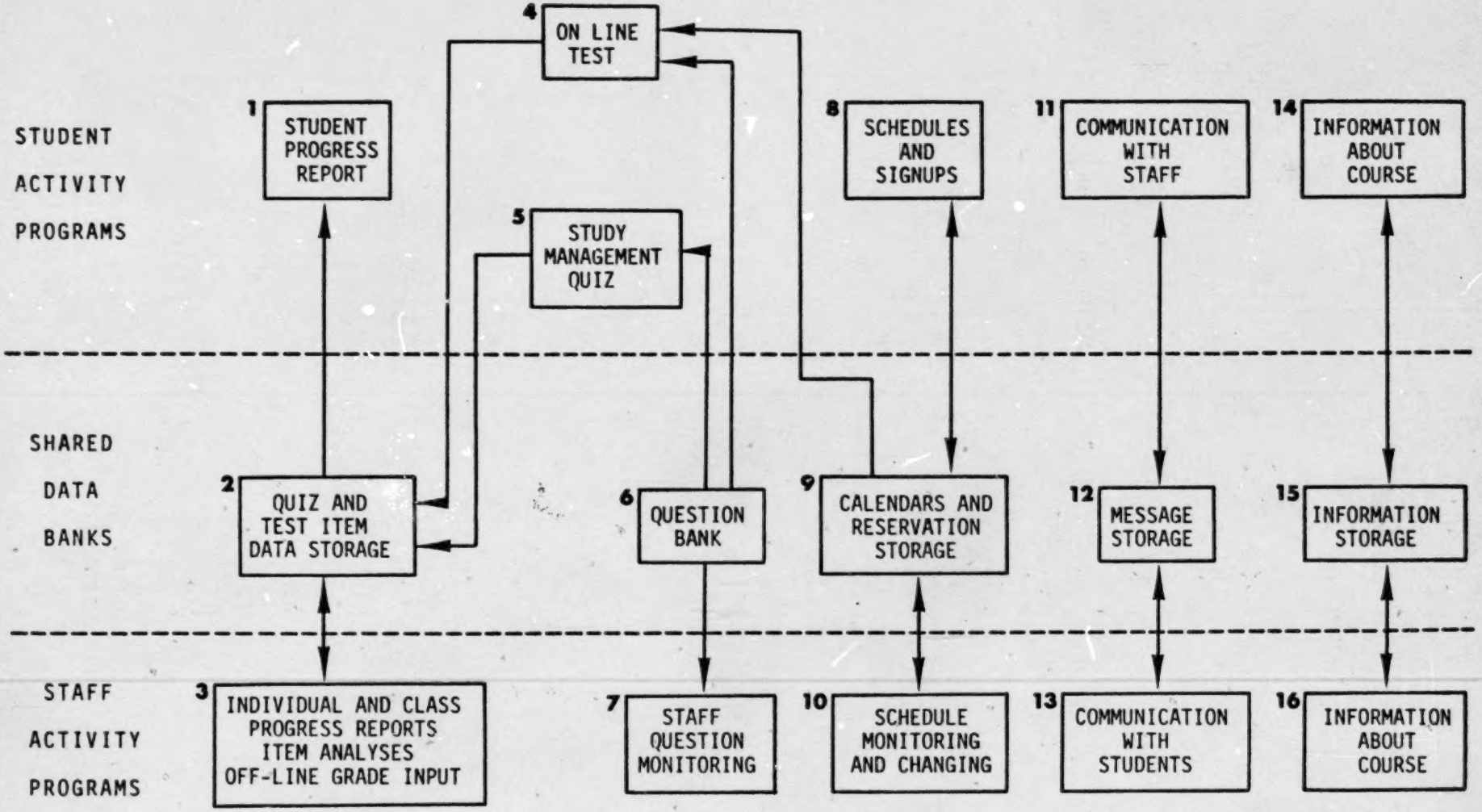
1. Index of student options in the course management system.

2. Index of staff options in the course management system.

3. Diagram of interactions between TUTOR programs and data banks.


STUDENT SIGNS ON TERMINAL
(NAME, COURSE, PASSWORD)
THE STUDENT CAN CHOOSE TO:
a. Read course information and procedures.
b. Inspect reports of study management progress and test performance.
c. Inspect current distribution of grades in course.
d. Compose messages to instructors.
e. Read messages from instructors.
f. Reserve a terminal for future study sessions.
g. Inspect seminar rosters.
h. Enroll in a seminar.
i. Review 'practice' items in preparation for on-line tests.
j. Reserve a terminal to take an OLT.
k. Take an on-line test.
l. Take a study management quiz.
STUDENT USUALLY RECEIVES STUDY ASSIGNMENT AND LEAVES TERMINAL
STUDENT DECISION
GOES HOME SESSION ENDS
CONTINUES STUDYING


STUDENT NEEDS TUTORIAL ASSISTANCE
STAFF NEEDS MANAGEMENT INFORMATION
RESEARCHERS NEED EVALUATION INFORMATION
STAFF SIGNS ON TERMINAL
(NAME, COURSE, PASSWORD)
THE STAFF CAN CHOOSE TO:
a. Read course information and procedures.
b. Read messages from students.
c. Compose messages to individual students and to 'all students'.
d. Inspect and alter seminar rosters.
e. Add and delete seminar offerings.
f. Inspect and alter sign-up rosters for on-line tests (OLTs).
g. Determine the site and number of terminals to be used during each testing session.
h. Inspect current distributions of grades in course from all students or certain subsets of students.
i. Inspect reports of study management progress and test performance of individual students, or summative reports from groups of students.
j. Add or alter students' seminar and final exam grades.
k. View any question used in the study management part of the course.
l. View any question used in the OLTs.
STAFF LEAVES TERMINAL


STUDENT ACTIVITY PROGRAMS
SHARED DATA BANKS
STAFF ACTIVITY PROGRAMS
1 STUDENT PROGRESS REPORT
2 QUIZ AND TEST ITEM DATA STORAGE
3 INDIVIDUAL AND CLASS PROGRESS REPORTS ITEM ANALYSES OFF-LINE GRADE INPUT
4 ON LINE TEST
5 STUDY MANAGEMENT QUIZ
6 QUESTION BANK
7 STAFF QUESTION MONITORING
8 SCHEDULES AND SIGNUPS
9 CALENDARS AND RESERVATION STORAGE
10 SCHEDULE MONITORING AND CHANGING
11 COMMUNICATION WITH STAFF
12 MESSAGE STORAGE
13 COMMUNICATION WITH STUDENTS
14 INFORMATION ABOUT COURSE
15 INFORMATION STORAGE
16 INFORMATION ABOUT COURSE